Use of Pavement Condition Data in Highway Planning and Road Life Studies

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•BEFORE progressing too far into the discussion of use of pavement condition data in highway planning and road life studies, the term road life should be clarified. These studies more appropriately should be called highway service and investment studies, as they are not only a study of how long various roadway surfaces last before they are resurfaced or reconstructed by also the determination of the annual cost of pavements by surface types, by highway control sections, by routes, and by systems. Also included are such studies as the original cost of highways, roads and streets for grading, surfacing and structures; the investment remaining in each item; and the depreciated investment remaining or the service that has been built in the highway system over the years. In addition, the road life studies include the determination of the service life of the investment in grading, surfacing and structures, and an estimate of highway needs based on the correlation of the forecasted traffic and the depreciated investment remaining. The Bureau is presently working on the annual costs of highways to support different weights and sizes of commercial vehicles. Over the past 15 years the Bureau has encouraged and assisted the States in obtaining detailed information concerning the operation of highways for use in future planning. This work has been accomplished through the promotion of the control section concept and the use of uniform reporting procedures.

There are many more studies included in the road life studies but only two are discussed that tie in directly with the use of pavement condition data: First, work with the States in obtaining detailed information concerning the construction, maintenance and operation and the condition of the highways; and second, the determination of the service lives of the various wearing surfaces for a particular section of highway.

Realizing early in the study of the service lives of pavements, that the results would be only as good as the information on which they were based, the States were continously assisted in improving their reporting procedures. Each State highway department was visited and the use of highway control sections as a basic procedure for keeping adequate cost and operating records of the highway plant was discussed. In 1953 the HRB Committee on Highway Costs prepared Special Report 13, entitled "Know Your Highway Costs." This manual pointed out the limited amount of highway data being obtained by the States for future planning and recommended that such basic information as construction and maintenance costs, traffic, accidents, and the condition of the pavement be kept by segments of the highway called control sections. Of course there were some pioneer States like Michigan that had well-organized pavement condition surveys that dated back to the middle 1920's and California and Oregon that had established control sections in the middle 1930's. Good progress was made on improving the procedures for recording the construction and maintenance costs, some improvement in recording traffic by control sections, but little improvement was made by the States in obtaining information concerning the condition of the pavements. Then the HRB Committee on Pavement Condition Surveys published Special Report 30 in 1957, a manual establishing a uniform procedure for reporting the conditions of the pavements. This was a great help in one of the road life studies which had to do with the reasons for the retirement of a pavement, whether due to obsolescence or structural deterioration. Structural deterioration was further segregated as to whether the reason for retirement was surface failure with the base and subgrade sound; surface and base failure, with the subgrade sound; and surface and base failure resulting from failure of the subgrade.

Because it was impracticable for road life personnel to obtain this retirement information by a field inspection, they reviewed plans of the original construction and subsequent resurfacing and reconstruction operations and relied on the personal opinion of highway department employees who were familiar with the roads. In a few States this information was obtained from pavement condition studies. Since the suggested criteria for HRB Special Report 30 was published in 1957 most of the information for the road life studies as to reason for retirement has been obtained from the pavement evaluation work. This removed much of the personal opinion on which the study had been based and the work of forecasting how long pavements would last and preparing replacement programs for highway needs studies had greater acceptance.

To remove from the realm of speculation the important item in highway transportation economics of the average life of pavements, in the past years three service life studies have been made. Now another one to show the effects of the stepped-up highway program on the average life of pavements is being prepared. To those interested in the development and maintenance of economical highway systems, the importance of reliable average lives of the various types of roadway surfaces need not be emphasized. It is with reliable average lives that the time of needed future construction can be forecast, that the actual annual economic cost of highway transportation can be calculated, and that the true annual cost of various surface types can be determined. Most of you are familiar with the Bureau's road life procedures for determining the average lives of pavements and that they are a study of actual lives realized for particular sections of highway up to the time when the surfaces are reconstructed, resurfaced, or abandoned. From an analysis of these actual lives it is possible by statistical methods (survivor curves) to calculate a general average life for the type of pavement under consideration.

Figure 1 shows the Bureau's curve method of determining the average service lives of pavements. The solid lines show the actual retirement experience for 1934 and 1935 construction and the dashed lines the matching type survivor curve. These type survivor

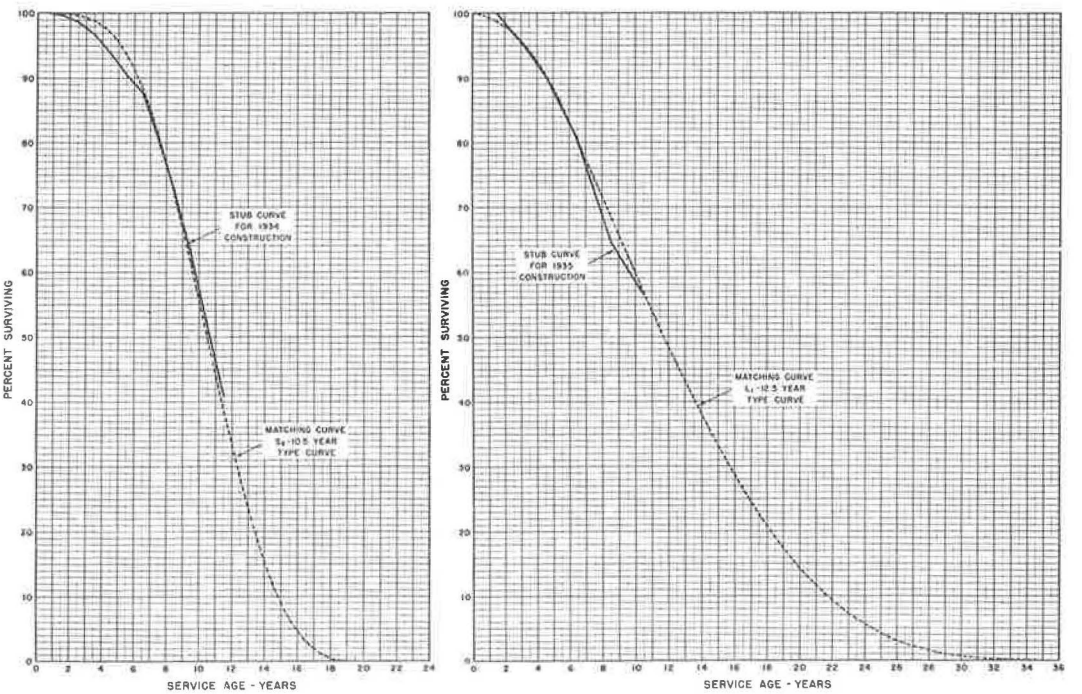

Figure 1. Survivor curves for 1934 and 1935 construction.

curves are from the Iowa Experimental Station Bulletin 125, Retirement of Industrial Properties. These curves were selected because of their good fit. Some of the retirements are mavericks and do not follow a curve at all. Utilizing these matching type survivor curves it is possible to forecast when surfaces will need resurfacing or reconstruction. These service lives are useful in the overall study of retirements and replacement trends but are only averages and do not necessarily apply when a study is confined to an individual section of highway.

Not being satisfied with only average service lives, pilot studies were undertaken to determine the service lives of individual sections of highway. Several State highway departments participated in these studies which were made by a field appraisal of each section of pavement. Even though the State Highway personnel who made these studies brought with them a broad and dependable background of engineering experience, the answers were still based on a considerable amount of judgment. Continuing research of various methods to determine the service lives for individual sections of pavement showed no startling results. However, renewed interest has been generated in this area by the work published on the evaluation of pavement performances and the prediction of future resurfacing operations through the use of the CHLOE profilometer. It is hoped that with the present serviceability index (PSI) taken just before a pavement is resurfaced or reconstructed, related to the age of the pavement and the condition of the pavement obtained from a pavement condition study, to be able to determine the service lives of individual sections of pavement and to forecast the service lives of other similar pavements.

Figure 2 shows a hypothetical case of a portland cement concrete pavement built in 1960 and serviceability ratings taken at 1960, 1964, 1968, 1972, and 1975 and a forecast

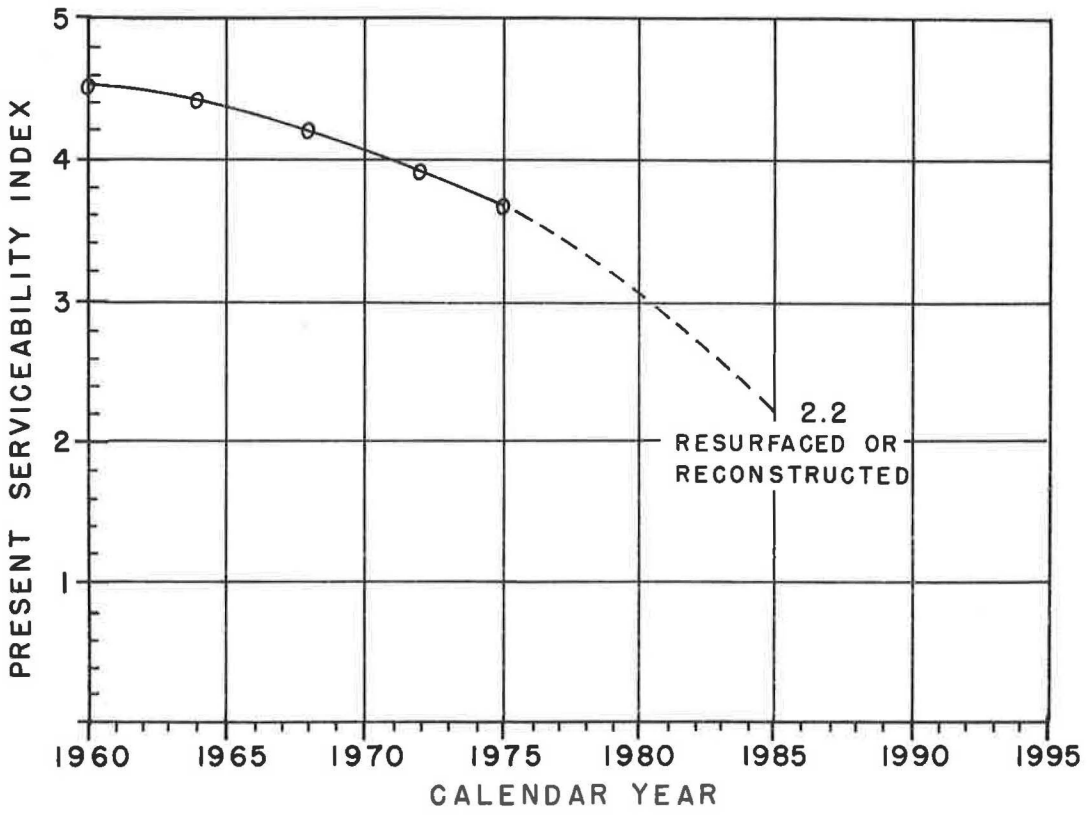

Figure 2. Portland cement concrete—PSI related to years (hypothetical).

to the year 1985. In 1985 it is estimated that the pavement should be resurfaced or reconstructed. Of course the percent of serviceability at which it is indicated that something should be done may differ for each State highway department or by surface types. This type of information has great possibilities in highway needs studies; for example, whether the operation should be included in the first 5 years of a desired construction program or the second 5-year period. This information can easily be revised after each service rating if it does not follow the forecasted trend. In addition there may be a correlation between PSI and the traffic, both amount of daily traffic and the composition of the traffic, which would be helpful. Only time and additional study will tell if progress is being made in the right direction.

It is hoped that this presentation has brought out the importance placed on pavement condition information in the road life studies and the great possibilities of its future use in studies of highway transportation.